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WE CLAIM

1. A receiver for detecting and recovering data from at least one set of received signal samples, said signal samples comprising a plurality of data bearing signal samples and a plurality of guard signal samples before or after the data bearing signal samples, said guard signal samples being formed by repeating a plurality of said data bearing signal samples, said receiver comprising

a matched filter having an impulse response,

a controller operable to adapt the impulse response of said matched filter to the signal samples of the guard signal samples, said matched filter being operable to produce an output signal which is representative of the convolution of the guard signal samples of said set with said set of received signal samples, and

a synchronisation detector operable to estimate the location of a sync position, consequent upon a distribution of energy with respect to time of said matched filter output signal with respect to said received samples, said sync position providing the position of a window of said received signal samples from which said data may be recovered from said data bearing signal samples.

2. A receiver as claimed in Claim 1, wherein said controller is operable to control said matched filter to convolve said received signal samples with said matched filter impulse response starting from a coarse estimate of said sync position providing a temporal location of said guard signal samples, receiver comprising

a correlator operable

to correlate two samples from said set of received signal samples separated by a temporal displacement corresponding to the temporal separation of the samples of the guard period and the data bearing signal samples from which the guard signal samples have been formed, said controller being operable to determine said correlation between said two samples at each of a plurality of relatively displaced positions along said received signal samples, and said synchronisation detector is operable

to determine an output value of said correlator for each of said relatively displaced positions, and

to estimate said coarse sync position estimate in accordance with the displaced position which produces the greatest output value from the correlator.

3. A receiver as claimed in Claim 2, wherein said synchronisation detector is operable to estimate said coarse sync position by determining an amount of energy within a shortened averaging window having a number of samples equal to the number of guard signal samples divided by an integer number, the energy within said shortened averaging window being determined for each output value from said correlator produced for each of said relatively displaced positions falling within said shortened averaging window, said coarse estimate of said sync position being determined in accordance with the relative position of said shortened averaging window having the most energy.

4. A receiver as claimed in Claim 1, wherein said receiver is operable to process a plurality of said sets of received signal samples, said synchronisation detector being operable to combine said output signal from said synchronisation detector for each of a plurality of sets of received signal samples, and to estimate said sync position from a peak value of said combined output signal.

5. A receiver as claimed in Claim 1, wherein said output signal has a plurality of temporally separated peaks, said synchronisation detector being operable to pre-process said output signal by identifying the temporal position of said peaks within said output signal which have an amplitude which is less than a pre-determined threshold, and setting the value of said output signal to a predetermined default value at said identified temporal positions, said sync position being determined from said pre-processed output signal.

6. A receiver as claimed in Claim 5, wherein said default value is zero.

7. A receiver as claimed in Claim 1, wherein said synchronisation detector is operable to process said output signal by

generating a representation of the amount of energy in the said output signal within a period corresponding to the temporal length of said guard signal samples, for each of a plurality of relative displacements of said guard period with respect to said output signal, and

determining the relative displacement of said period having the most energy, and

identifying the start of an analysis window of said output signal from the temporal position of the beginning of said guard period at said relative displacement of most energy, said sync position being determined from within said analysis window of said processed output signal.

8. A receiver as claimed in Claim 7, wherein said synchronisation detector is operable to determine the end of said analysis window by

reversing said output signal in time,

generating a representation of the amount of energy in the said reversed output signal within said guard period, for each of a plurality of relative displacements of said guard period with respect to said reversed output signal,

determining the relative displacement of said period having the most energy, and

identifying the end of said analysis window of said output signal form the temporal position of the beginning of said guard period at said relative temporal displacement of most energy.

9. A receiver as claimed in Claim 1, wherein said synchronisation detector is operable to pre-process said output signal by

locating the relative temporal position of the maximum peak within said output signal,

identifying for each other peak sample of said output signal another sample of said output signal at an opposite corresponding temporal displacement with respect to said relative temporal position of said maximum peak, comparing these two samples and replacing the lower of the two samples with zero.

10. A receiver as claimed in Claim 1, wherein said data is modulated onto said data bearing signal samples in the frequency domain and transformed to said data bearing signal samples into the time domain to form the data bearing signal samples of said set of received signal samples, said receiver further comprising a forward fourier transformer operable to recover the data by performing a forward fourier transform on the signal samples within said window.

11. A receiver as claimed in Claim 10, wherein said data is modulated in accordance with Orthogonal Frequency Division Multiplexing or Coded Orthogonal Frequency Division Multiplexing or the like.

12. A receiver as claimed in Claim 1, wherein said set of received signal samples are complex samples having real and imaginary parts, said impulse response having complex samples, and said controller being operable

to represent the real and imaginary components of each of said received signal samples as a positive or negative constant in dependence upon the relative sign of said real and imaginary components, and

to represent the real and imaginary components of the samples of said matched filter impulse response as a positive or negative constant in dependence upon the relative sign of said real and imaginary components, said matched filter being operable to convolve said impulse response with said received signal samples by logically combining the representation of said received signal samples and said impulse response.

13. A receiver as claimed in Claim 12, wherein said logical combining of said received signal samples and said impulse response is summing the XOR compliment of the combination of the representation of said received signal samples and said impulse response.

14. A receiver as claimed in Claim 13, wherein said matched filter is operable to perform the convolution of said impulse response with said received signal samples in accordance with the following equation:

$$h_m(n).I = \sum_{i=0}^{N_g-1} 2 * \overline{XOR}\big(f_m(n-i).I, r(n-i).I\big) - 1$$

$$h_m(n).Q = \sum_{i=0}^{N_g-1} 2 * \overline{XOR}\big(f_m(n-i).Q, r(n-i).Q\big) - 1$$

where $\overline{XOR}(a,b)$ is the compliment of XOR(a, b), $h_m(n).I$ is the real part and $h_m(n).Q$ the imaginary part of the complex samples of said output signal.

15. A method of detecting and recovering data from at least one set of received signal samples, said set of signal samples comprising a plurality of data bearing signal samples and a plurality of guard signal samples before or after the data bearing signal samples, said guard signal samples being formed by repeating a plurality of said data bearing signal samples, said method comprising

adapting the impulse response of a matched filter to the signal samples of the guard signal samples,

producing an output signal which is representative of the convolution of the guard signal samples of said set with said received signal samples, and

estimating the location of a sync position, consequent upon a distribution of energy with respect to time of said matched filter output signal with respect to a relative convolution position in said received samples, said sync position providing the position of a window of said received signal samples from which said data may be recovered from said data bearing signal samples.

16. A method as claimed in Claim 15, comprising

controlling said matched filter to convolve said received signal samples with said matched filter starting from a coarse estimate of said sync position,

correlating two samples from said set of received signal samples, separated by a temporal displacement corresponding to the temporal separation of the samples of the guard period and the data bearing signal samples from which the guard signal

samples have been formed, at each of a plurality of relatively displaced positions along said received signal samples, ,

determining an output value of said correlator for each of said relatively displaced positions, and

generating said coarse estimate of said sync position in accordance with the displace position which produces the greatest output from the correlator.

17. A method as claimed in Claim 16, wherein said generating said coarse estimate of said sync position comprises

- determining an amount of energy within a shortened averaging window having a number of samples equal to the number of guard signal samples divided by an integer number, the energy within said shortened averaging window being determined for each output value from said correlator produced for each of said relatively displaced positions falling within said shortened averaging window, and

- determining said coarse estimate of said sync position in accordance with the relative position of said shortened averaging window having the most energy

18. A method as claimed in Claim 15, comprising

processing a plurality of said sets of received signal samples,

combining said output signal produced for each of a plurality of sets of received signal samples, and

estimating said sync position from a peak value of said combined output signal.

19. A method as claimed in Claim 15, wherein said output signal has a plurality of temporally separated peaks, said method comprising

identifying the temporal position of said peaks within said output signal which have an amplitude which is less than a pre-determined threshold,

setting the value of said output signal to a predetermined default value at said identified temporal positions, said sync position being determined from said pre-processed output signal.

20. A method as claimed in Claim 19, wherein said default value is zero.

21. A method as claimed in Claim 15, comprising

generating a representation of the amount of energy of said output signal within a period corresponding to the temporal length of said guard signal samples, for each of a plurality of relative displacements of said guard period with respect to said output signal,

determining the relative displacement of said period having the most energy, and

identifying an analysis window of said output signal, said analysis window starting from the temporal position of the beginning of said guard period at said relative displacement of most energy, said sync position being determined from within said analysis window of said output signal.

22. A method as claimed in Claim 21, comprising

reversing said output signal in time,

generating a representation of the amount of energy of said reversed output signal within said guard period, for each of a plurality of relative displacements of said guard period with respect to said reversed output signal,

determining the relative displacement of said period having the most energy, and

identifying the end of said analysis window of said output signal from the temporal position in said reversed output signal corresponding to the start of said guard period at said determined relative displacement of most energy.

23. A method as claimed in Claim 15, comprising

locating the relative temporal position of the maximum peak within said output signal,

identifying for each other peak of said output signal the value of said output signal at an opposite corresponding temporal displacement with respect to said relative temporal position of said maximum peak, and

if said output signal value at said corresponding displacement is less than said peak value, setting said output signal value to zero.

24. A method as claimed in Claim 15, wherein said data is modulated onto said data bearing signal samples in the frequency domain and transformed to said data bearing signal samples into the time domain to form the data bearing signal samples of said set of received signal samples, said method comprising

performing a forward fourier transform on the signal samples within said window.

25. A method as claimed in Claim 15, wherein said set of received signal samples are complex samples having real and imaginary parts, said impulse response having complex samples, said method comprising

representing the real and imaginary components of each of said received signal samples as a positive or negative constant in dependence upon the relative sign of said real and imaginary components, and

representing the real and imaginary components of each of the samples of said matched filter impulse response as a positive or negative constant in dependence upon the relative sign of said real and imaginary components, said matched filter being operable to convolve said impulse response with said received signal samples by logically combining the representation of said received signal samples and said impulse response.

26. A computer program providing computer executable instructions, which when loaded onto a computer configures the computer to operate as a receiver as claimed in Claim 1.

27. A computer program providing computer executable instructions, which when loaded on to a computer causes the computer to perform the method according to Claim 15.

28. A computer program product, including a computer readable medium having recorded thereon information signals representative of the computer program claimed in Claim 27.

29. A computer program product, including a computer readable medium having recorded thereon information signals representative of the computer program claimed in Claim 28.